Safety Insights Series:
Enclosed Space Entry

This RightShip Insights series provides industry partners with key learnings from industry incidents, identified gaps and leading practices to improve standards and mitigate risk.

Observations:

Since 2019, RightShip assessed a selection of 611 incidents that resulted in fatalities. Of these, 35 happened in enclosed spaces resulting in 46 lives lost. These tragic incidents could have been avoided, if certain preventative or mitigating controls had been in place.

This paper discusses issues around **Enclosed Space Entry Onboard Dry Bulk Vessels,** and:

- Observations on avoidable fatalities;
- Insights from the RISQ Inspections outcome;
- Where to find further information.

Note: There is no reference to companies or vessels involved in the cases described in this paper.

RISQ Questions:

Since its introduction to the industry in May 2021, Section 4 (ISM) of the RISQ questionnaire includes three questions specifically addressing the processes, procedures, permits, training, and safety equipment related to entry into enclosed spaces.

These questions are:

4.5 *Is the vessel provided with an enclosed space entry procedure, and is there documented evidence that it was followed, and is there evidence that the crew assigned to responsibilities requiring entry into enclosed spaces has attended a dedicated enclosed space entry course?*

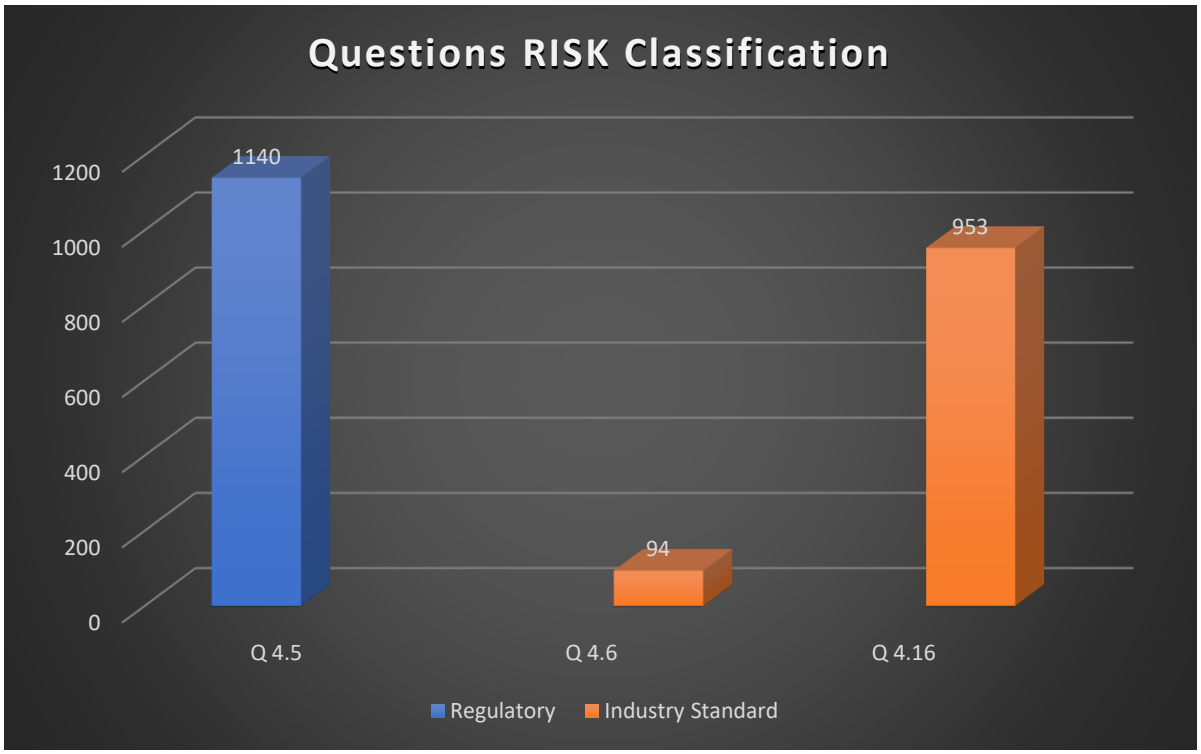
4.6 Is entry into and rescue from enclosed space training undertaken and are regular drills conducted? (V)?

4.16 Are portable gas detectors suitable for atmosphere testing of enclosed spaces provided; in good condition; calibrated in accordance with the manufacturer's instructions, and are officers trained and competent with their operation? (V & M)

RISQ Questions Risk Classification:

Each RISQ question receives a risk classification depending on whether it originates from an industry standard or a regulatory compliance requirement.

An examination of RightShip Inspections' RISQ inspections reveals that from September 2021, to September 2024, RightShip conducted 7,707 RISQ inspections. Findings related to entry into enclosed spaces amounted to a significant 2,187 findings, categorised according to the chart below.

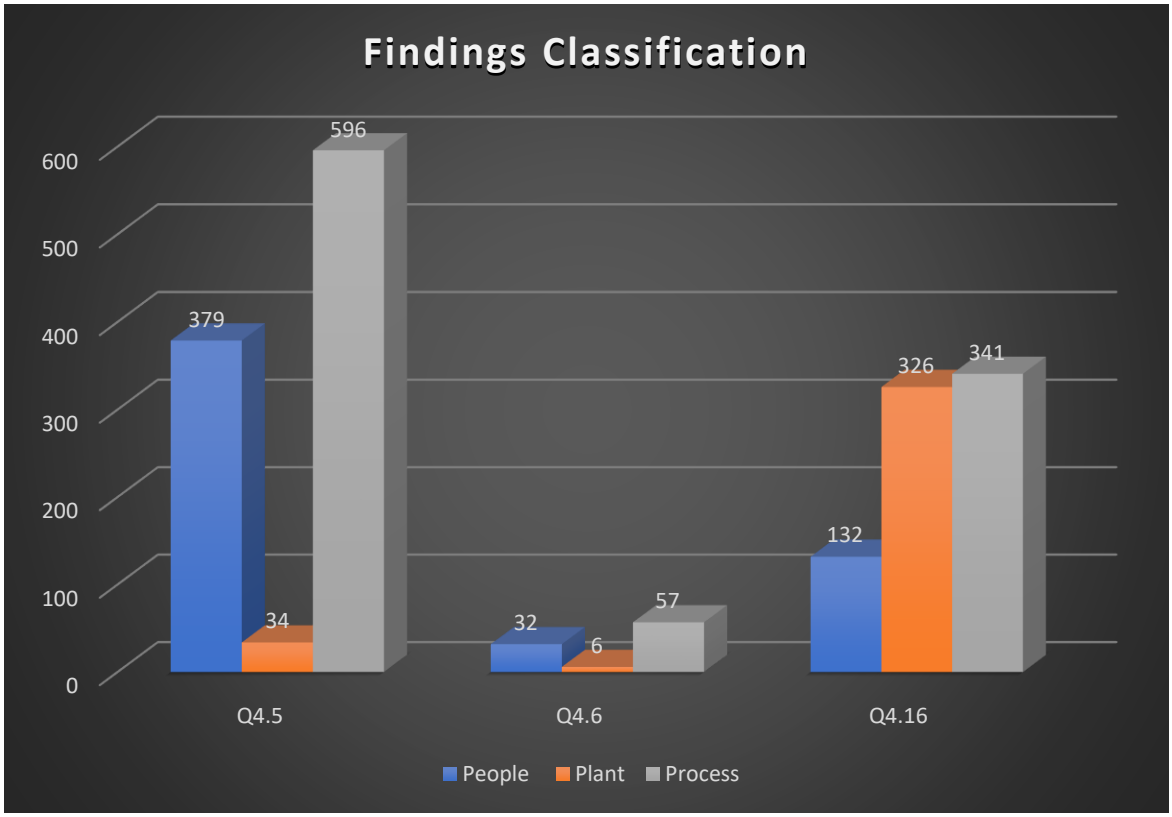


RISQ Findings Classification:

Each[1] finding resulting from a RISQ inspection is attributed to one of the following categories:

- People
- Plant (equipment), or
- Process

[1] Only 1,903 out of the 2,187 findings were classified under these categories as this classification began only in 2023.



The chart reveals that the highest number of findings was linked to:

1 Process, totaling a remarkable 994 findings.

2. Following closely was People, with 543 findings.

3. Plant (equipment) came in third place with 366 findings.

Examples of RISQ Inspections Findings Linked to incidents:

1. Cargo hold manholes were all marked as enclosed spaces. However, stevedores were accessing the cargo holds freely without any means of control.
2. Cargo hold number 1 forward entrance is located inside a dedicated space with a water tight door where the entrance has no manhole cover. The space was not marked as an enclosed space. No permits were issued prior to the space entry. This space was not identified in the shipboard enclosed space.
3. Task risk assessment for entry into enclosed spaces (and all other risk assessments) were print outs from the company's produced Risk Assessment library. No actual risk assessment took place. The risk assessment was not ship specific. No additional risks or mitigation measures

were identified. No ship specific list/register of enclosed spaces was compiled on board. For example, access to cargo hold no. 1 is located inside the hydraulic pump room inside the forecastle store. The room was not marked as enclosed space.

4. The vessel was equipped with two multi gas detectors. The calibration certificate listed their expiry date as 05 Jan 2024 and 31 Mar 2024 respectively. These multi gas detectors were used for an enclosed space entry on 09 April 2024 to clean No. 1 D.O. Service Tank.

RightShip Notes

1. Among the mentioned examples, example number 1 is particularly noteworthy as it directly contributed to a recent tragedy where three shore stevedores lost their lives on board a vessel after entering a cargo hold unchallenged through a manhole access.
2. On the other hand, examples number 2 and 3 were contributing factors to a forecastle explosion that caused a fatality while the vessel was transporting a coal cargo. The space contained methane and lacked an explosion-proof light fixture.
3. A similar issue led to an O/S fatality when they were sent to retrieve tools from the store. Unaware of the danger present, the individual entered the space, resulting in their untimely death.

Extended examples list is included in Annex (1).

RightShip Analysis

For the purpose of this insight's paper, we will only focus on three main topics that we have identified as major contributors to several preventable fatalities. These are:

1. Control of stevedores' and contractors' access to Enclosed Spaces on board.

Incident 1: Fatal injuries to three stevedores in a cargo hold on board a bulk carrier while loading coal.

Incident 2: A shore worker was discovered unconscious in the cargo hold after entering during fumigation procedures.

2. Identification of Enclosed Spaces onboard and their associated risks

Incident 1: Cargo hold no. 1 booby hatch was located inside the windlass pump room which was located inside the forecastle store. In preparation for the arrival, crew members proceeded forward to prepare the anchors. Two crew members proceeded inside the windlass pump room to start the hydraulic pump. Once the button was pressed, an explosion took place. Crew members were severely burned. No gas measurement or ventilation were performed prior to entering into the forecastle store or the pump room.

Incident 2: Explosion in the carpenter's store due to methane ignition that led to 5 crew members sustaining burns with varying degrees with some sustaining fractures to the leg and/or the forearm.

3. Crew's Risk Perception

Crew risk perception plays a crucial role in ensuring safety onboard ships, especially concerning enclosed spaces entry and the rising fatalities associated with it. Unfortunately, there are instances where crew members may lack a proper understanding or appreciation of these risks, leading to potentially hazardous situations.

For example, consider a scenario where crew members underestimate the dangers of entering a confined space without adequate ventilation or safety measures. This lack of risk perception can result in accidents such as asphyxiation or exposure to toxic gases, putting lives at risk.

Another example could involve crew members who become complacent due to routine tasks, assuming that they are familiar with the environment and therefore neglecting proper safety protocols. This complacency can lead to overlooking potential hazards or taking unnecessary risks, leading to accidents and fatalities.

What went wrong?

The investigations have pinpointed several critical factors that contributed to these serious incidents. These factors include:

1. Lack of procedures to regulate or limit the stevedores' access to enclosed spaces on board.
2. Inaccurate/incomplete identification of enclosed spaces on board, lacking a comprehensive, ship-specific list.
3. Lack of familiarity among the crew with the ship's enclosed spaces.
4. Inadequate labeling of enclosed spaces, causing clarity issues.
5. Crew difficulties in understanding the risk assessment process, often completing assessments as mere paperwork exercises rather than objectively and for their intended benefit.
6. Exclusion of junior officers and ratings from the risk assessment process, resulting in their unawareness of associated risks and hazards, as senior officers conducted the assessments.
7. Issuance of enclosed space entry permits before completing the risk assessment.
8. Failure to mark fumigated spaces as required by Res.A 1050(27).
9. Failure to secure enclosed spaces to prevent unauthorized access, as required by Res.A 1050(27).
10. Lack of proper ventilation and/or atmosphere measurements.
11. Lack of proper testing/examination of bulkhead penetration sealing.
12. Lack of knowledge, training, understanding of cargo associated risks.

13. Lack of training on fumigation and fumigants associated risks.
14. Vessels are not supplied with proper gas detectors that are capable of measuring gases emitted by the carried cargo/s.

RightShip Comments:

1. The circular MSC.1/Circ.1264 extensively employs the terms "seal," "sealed," and "sealing" in various contexts. However, its primary relevance lies in ensuring the gas-tight integrity of cargo holds post-fumigation to prevent gas leakage. Achieving this for weather-tight cargo holds necessitates the use of sealing tapes, with some opting for additional measures like plastic zip ties to signal against accidental opening and fumigation loss. Despite these precautions, managers and crew must still adhere to Res.A. 1050(27) requirements for securing cargo holds against unauthorized entry.

2. According to COSWP (2022) and the General Precautions outlined in section 6.1 of A 27/Res.1050, entry doors or hatches leading to enclosed spaces must remain secured against entry when not in use.

What good managers do?

Operators have also implemented the following, in addition to those listed in the first enclosed spaces entries insight's paper.

1. Establish procedures to control stevedores and contractor's movement onboard, access to enclosed spaces and potentially hazardous areas onboard.
2. Implement a buddy system for crew members
3. Encourage the use of stop work authority and share real-life examples with all ships in their fleets. A policy's effectiveness lies in its execution.
4. Conduct periodical risk assessments to evaluate the potential need to revise the enclosed spaces list onboard.
5. Enhance crew's risk assessment training while involving not only senior officers but also junior and the ratings who are involved in carrying out the task.
6. Provide comprehensive training programs that highlight the risks associated with enclosed spaces entry, certain cargoes and conditions. While, emphasizing the importance of following safety procedures, and conducting regular drills to reinforce learning.
7. Enhance the enclosed spaces drills and rescue training by alternating the drill locations to expose the crew to different challenges.
8. Establish clear communication channels for reporting safety concerns, near misses, and incidents without fear of reprisal. Encouraging a culture of open dialogue where crew members feel empowered to voice their concerns regarding safety.

9. Arrange the proper supply and usage of the correct type gas detectors, remote monitoring, and communication devices to enhance safety monitoring and provide real-time alerts in case of potential hazards.
10. Ensure that the gas detectors validity does not laps. Ensure that the calibrations tools, equipment, gases, manuals are readily available onboard.
11. Enhance their internal auditing procedures to include enclosed space entries related activities.
12. Implement behavioral based safety approach.
13. Improve the company's safety culture (both onboard and ashore) through rewarding safe practices, conducting effective safety audits, and involving all levels of the crew in safety risk assessment processes.

By addressing crew risk perception through these measures, it is possible to improve safety awareness, reduce tragic incidents and create a safer working environment onboard ships.

Appendix (1)

Extended list of Examples of RISQ Inspections Findings related to Enclosed Space Entry

RISQ (Q 4.5) Are enclosed space entry procedures defined, up to date and accurate in the safety management system, and is a specific list of enclosed spaces clearly defined on board and are the ship's personnel familiar with the enclosed space entry procedures?

1. There was no ship specific list of which spaces were to be considered as enclosed spaces requiring a permit.
2. Two enclosed space entry permits were reviewed for 12 Feb 2024 and 31 Jan 2024. Both permits were filled in incorrectly. The chief officer was the team leader entering the tank. Yet, he was also the assigned responsible person/the authorized person as well as the standby person. He signed for all three roles.
3. 20 enclosed spaces entry permits were issued since 01 Jan 2023. The last was 27 Jul 2023 for the purpose of inspecting WBT no 4 and 5 Port and Starboard. Crew referred to the risk assessment process as once a year review of the onboard library and recording such review. No risk assessment was issued for entry into enclosed spaces. Not even a signed pre-completed RA from the library.
4. Cargo hold manholes were all marked as enclosed spaces. However, stevedores were accessing the cargo holds freely without any means of control.
5. Enclosed space entry permits showed the crew entering the FWTK at 08:15 hrs and exiting at 15:00 hrs. All exits and re-entries in between were not recorded. No atmosphere measurement

was made prior to re-entry. There were no records to show that the atmosphere was continuously monitored while the space was occupied.

6. In the enclosed space entry permit of 18-Mar-2024, two ballast tanks were recorded on a single permit (Fore Peak and TST 2P). A single gas test was recorded at 08.30 hrs but the results recorded did not state which tank was tested. Entry was made by two crew at 08.40 and exit at 10.10 hrs. Again, the permit did not state if this was one tank or covered entry into the first before exit from the second. Additionally, the Master had approved the permit at 08.27 hrs, which was before the initial gas tests were made.
7. a) Risk Assessment process was not understood by crew.

   b) No risk assessment was ever issued/conducted for any enclosed space entry onboard.

   c) Cargo hold number 1 forward entrance is located inside a dedicated space with a watertight door where the entrance has no manhole cover. The space was not marked as an enclosed space. No permits were issued prior to the space entry. This space was not identified in the shipboard enclosed space.

   d) Enclosed space entry permit was issued for ballast tanks and void spaces entry. However, initial atmosphere check results were never recorded on the form.

   e) Reporting intervals were agreed as every two minutes on every enclosed space entry permit, the form does not include a dedicated table to record such reports/checks. Thus, none were recorded.

   f) The form did not include a table to record atmosphere checking results while the space is occupied by crew.
8. There was no record of training for any officer for enclosed space entry training. The Chief Officer - the Safety Officer- was not aware of a ship specific enclosed space list of those areas requiring a permit. Because of the failure of the ballast water remote control valve system, it was necessary to enter the pipe tunnel to manually open the valves. There were no entry permits on file for any crew going into to the pipe tunnel to operate the valves. The Fore Peak tank had been inspected on 05 Dec 2023. To enter the Fore Peak, it was necessary to cross the Forward Void. There was no entry permit for the Void. The Fore Peak entry permit for that day was completed by the Chief Officer who made the initial gas tests and then signed himself as the attendant at the tank, the person supervising entry and the person responsible for safety. He was also listed as a person entering the space and the team leader.
9. There was no record of enclosed space entry training of any type (classroom or CBT) for any of the officers onboard.
10. Task risk assessment for entry into enclosed spaces (and all other risk assessments) were print outs from the company's produced Risk Assessment library. No actual risk assessment took place. The risk assessment was not made ship specific. No additional risks or mitigation measures were identified. No ship specific list/register of enclosed spaces was complied on board. For example, access to cargo hold no. 1 is located inside the hydraulic pump room inside the forecastle store. The room was not marked as enclosed space.

RISQ (Q 4.6) Is entry into and rescue from enclosed space training undertaken and are regular drills conducted? (V)?

1. The last enclosed entry space rescue drill was reported at No.3P void on 29 Jan 2024. However, no entry permit was completed, and it was then stated that no-one entered the space. The previous drill was at the engine room escape hatch with its rigged block and tackle. These would not represent a challenging drill testing the crew's capabilities in realistic circumstances.
2. While drills were being conducted on a 2-monthly basis as required by the Manager's SMS, the drills used the steering room as the training location for three of the last four drills. (15 Nov 2023, 15 Sep 2023 and 19 May 2023, though not on 14 Jul 2023). Repeated use of the same space for the drill did not represent different and difficult circumstances to test the ship's emergency response.
3. The last two enclosed space rescue drills were held on 04 Mar 2023 and 07 Jan 2023. Both appeared to be simulation drills held on the bridge. The photos attached showed a replica lighting hole had been constructed from plywood, of the type found in vertical sections of the ballast tank, that the crew could train passing through. However, this did not represent a realistic enclosed space rescue drill e.g. using the rescue lifting equipment.
4. The last enclosed space entry and rescue drill was a lecture held in the crew mess room on 29-Apr-2023. No physical drill was carried out. On the previous drill of 17 Dec 2022, the drill record stated that there was a simulated rescue from an "E.S." (enclosed space). However, no enclosed space entry permit had been completed on that day.
5. The last three enclosed space entry drills were dated 19 Jan 2023 (Fore Peak), 25 Nov 2022 (Aft Peak) and 09 Sep 2022 (Fore Peak). In none of the three cases had an enclosed space entry permit been completed, which would indicate either no entry for rescue was made or that the crew entered without a permit.
6. No entry into enclosed space drill was performed since the vessel was taken over by the current managers 8 months ago.
7. The last enclosed space entry drill was on 23 Mar 2024 and was held on the main deck. The description provided indicated this was a lecture; no entry was conducted. This did not constitute effective testing of the ship's response plan for an emergency.
8. The last Entry into enclosed space drill was conducted in the galley which does not qualify as an enclosed space.
9. Last three enclosed space drills scenario was a copy/paste scenario for a drill inside the forecastle store. The drill scenarios included only entry without any training on rescue of personnel from an enclosed space.
10. The last entry into enclosed space drill was conducted on 23 of March 2024 at the paint store (two days before the inspection). During the crew’s interviews, no one was able to recall neither the date nor the location of the last entry and rescue from an enclosed space drill. Further, although the vessel was without gas detectors for the past 4 months, the atmospheric checks were recorded on the entry permit as conducted showing O2 value.

RISQ (Q 4.16) Are portable gas detectors suitable for atmosphere testing of enclosed spaces provided; in good condition; calibrated in accordance with the manufacturer's instructions, and are officers trained and competent with their operation?

1. The vessel was equipped with two multi-gas detectors. The calibration certificate listed their expiry date to be 05 Jan 2024 and 31 Mar 2024 respectively. These multi gas detectors were used for an enclosed space entry on 09 April 2024 to clean No. 1 D.O. Service Tank.
2. Both portable gas detectors were seen with reading "Cal due now". Vessel was not able to trace reason for this indication. Vessel had connected a long rope to gas detectors for lowering into enclosed Spaces to test atmosphere remotely. The vessel is equipped with one multi-gas detector. No span gas or other calibration equipment is available on board for regular tests and verification.
3. One multi- gas meter was available on board. Sampling hose in use is fitted with a hand pump. The sampling hose length was 7 meters which was not enough to reach the bottom of tanks such as Forepeak tank.
4. Vessel has 24 Single gas clip oxygen meters which are being used on a daily basis by the ship's crew as per manufacturer's requirements a bump test needs to be done prior each use and calibration carried out every 30 days none of which were carried out. No multi-gas detectors were supplied onboard.
5. 6 portable gas detectors on board are overdue for calibration by shore since 15 Aug 2022. No calibration instruments available on board.
6. Two new units supplied 1 Mar 22. No instruction manual provided. Chief Officer unable to demonstrate how remote sampling can be achieved.
7. The vessel was provided with one portable multi-gas detector with a built-in pump and one personal multi-gas detector. Calibration of both the multi-gas detectors is done by shore technicians once a year. There were no on-board calibration records sighted. The vessel was not provided with span gas for calibration.
8. The vessel has only one calibrated multi gas meter onboard. The vessel is not supplied with an adequate tube to measure atmosphere inside tanks.
9. The vessel was provided with only one multi-gas detector with hand pump. None of the officers was aware of how many pumps were required to withdraw an air sample from the other end of the provided sampling hose.
10. The Honeywell BW MicroClip XL multi-gas detector was last calibrated on 08 Mar 2021. Annual calibration is overdue since seven (7) months. The vessel could not demonstrate how remote sampling of enclosed spaces is done by hose and pump. It was stated that the gas detectors are lowered into the space tested by means of rope.